CLAIMS

1. A solar cell comprising: a first electrode layer, a second electrode layer, a p-type semiconductor layer interposed between the first electrode layer and the second electrode layer, and a n-type semiconductor layer interposed between the p-type semiconductor layer and the second electrode layer,

the p-type semiconductor layer comprising a compound semiconductor that contains a group Ib element, a group IIIb element and a group VIb element and that has a chalcopyrite structure,

the p-type semiconductor layer having a bandgap that increases from the n-type semiconductor side to the first electrode layer side monotonically,

a bandgap of the p-type semiconductor layer on the main surface at the n-type semiconductor layer side being at least 1.08 eV,

a bandgap of the p-type semiconductor layer on the main surface at the first electrode layer side being at least 1.17 eV, and

in the p-type semiconductor layer, a first region at the n-type semiconductor layer side and a second region at the first electrode layer side being different from each other in bandgap increase rate in a direction of thickness of the p-type semiconductor layer.

2. The solar cell according to claim 1, wherein the bandgap of the p-type semiconductor layer on the main surface at the n-type semiconductor layer side is at least 1.2 eV.

3. The solar cell according to claim 1, wherein the bandgap of the p-type semiconductor layer on the main surface at the first electrode layer side is at least 1.3 eV.

4. The solar cell according to claim 1, wherein the bandgap increase rate in the second region is smaller than the bandgap increase rate in the first

region.

5. The solar cell according to claim 1, wherein the group Ib element is Cu, the group IIIb element is at least one element selected from the group consisting of In, Ga and Al, and the group VIb element is at least one element selected from the group consisting of Se and S.

6. The solar cell according to claim 1, wherein the group IIIb element is at least one element selected from the group consisting of In, Ga and Al, and

a content of the at least one element in the p-type semiconductor layer changes in a direction of thickness of the p-type semiconductor layer.

7. The solar cell according to claim 6, wherein

the group IIIb elements comprise Ga,

an atom number ratio of Ga to the group IIIb elements in the p-type semiconductor layer increases from the n-type semiconductor layer side to the first electrode layer side monotonically, and

in the p-type semiconductor layer, the first region at the n-type semiconductor layer side and the second region at the first electrode layer side are different from each other in the atom number ratio in a direction of thickness of the p-type-semiconductor layer.

8. The solar cell according to claim 7, wherein the increase rate of the atom number ratio in the second region is smaller than the increase rate of the atom number ratio in the first region.

9. The solar cell according to claim 6, wherein

the group IIIb elements comprise Al,

an atom number ratio of Al to the group IIIb elements in the p-type semiconductor layer increases from the n-type semiconductor layer side to the

first electrode layer monotonically,

in the p-type semiconductor layer, the first region at the n-type semiconductor layer side and the second region at the first electrode layer side are different from each other in the atom number ratio in a direction of thickness of the p-type semiconductor layer, and

the first region at the window layer side and the second region at the first electrode layer side in the semiconductor layer are different from each other in the increase rate of the atom number ratio.

10. The solar cell according to claim 9, wherein the increase rate of the atom number ratio in the second region is smaller than the increase rate of the atom number ratio in the first region.

11. The solar cell according to claim 7, wherein the atom number ratio of the p-type semiconductor layer on the main surface at the n-type semiconductor layer side is at least 0.1, and

the atom number ratio of the p-type semiconductor layer on the main surface at the first electrode layer side is at least 0.25.

12. The solar cell according to claim 11, wherein the atom number ratio of the p-type semiconductor layer on the main surface at the n-type semiconductor layer side is at least 0.3.

13. The solar cell according to claim 11, wherein the atom number ratio of the p-type semiconductor layer on the main surface at the first electrode layer side is at least 0.45.